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Environmental Operating Guidelines: Hydrocarbon Well-sites in Northern Canada

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Hydrocarbon Well-sites in Northern Canada

Prepared by:

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for:
Land Resources, Northern Affairs Program

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Affaires indiennes et du Nord Canada

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Preface

This document is fourth in a series of guidelines designed to assist land use operators, land use managers and inspectors. It describes environmental operating guidelines for hydrocarbon well-sites in Yukon and Northwest Territories. The sequential steps of well-site planning, construction, operation, abandonment and restoration are discussed. So are current operational practices that afford environmental protection. The guidelines refer to the various terrain types, permafrost conditions, geographical areas and seasons of operation in northern Canada.

Information for the guidelines was obtained from:

- an industry/government workshop held to discuss and present current industry practises;
- an examination of Indian and Northern Affairs Canada (INAC)-sponsored research on drilling sumps;
- examination of environmental operating guidelines used by other jurisdictions and agencies for hydrocarbon exploration and development;
- a field examination of abandoned and operating hydrocarbon well-sites in Northwest Territories; and
- interviews with officials from industry and government.

The guidelines were prepared by Spencer Environmental Management Services Ltd. assisted by a Steering Committee composed of Chris Cuddy, Floyd Adlem, Perry Savoie of INAC and Richard Nancarrow of Canadian Oil and Gas Lands Administration (COGLA).

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Chapter 1

Introduction

Purpose of Document

During the late 1960's and early 1970's and following the discovery of hydrocarbons at Prudhoe Bay in Alaska, hydrocarbon exploration extended into the Mackenzie Delta, the Arctic Islands and northern Yukon. Partially in response to this exploration activity and a general environmental awareness, the federal government in the early 1970's introduced the Territorial Land Use Regulations and Northern Inland Waters Act as a means of affecting environmental protection on northern Canadian lands.

In the mid 1970's, northern hydrocarbon exploration activity shifted to offshore locations. During the early 1980's there has been a rejuvenation of interest in land-based exploration.

During its activities in northern Canada, the oil and gas industry has developed special environmental procedures for environmental protection. Concurrently, and since inception of the Territorial Land Use Regulations, government has conducted ongoing research, principally through the Arctic Land Use Research (ALUR) program, to refine land use permit operating terms and conditions. This research has especially identified and solved problems associated with drilling fluid sumps.

While southern Canadian jurisdictions (e.g. Province of British Columbia 1980, Canadian Petroleum Association 1977-1982) have developed environmental operating guidelines for hydrocarbon exploration, no guidelines specific to northern Canadian conditions have been prepared.

Considering this apparent void, renewed interest in land-based hydrocarbon exploration in northern Canada, several years of northern sump research, and a recognition that government and industry have developed environmental operating techniques for northern Canada, it is timely to synthesize all pertinent information and to develop a manual of environmental operating guidelines for northern Canadian conditions.

The purpose of this document is to communicate best operating practices to land use operators, administrators and managers. It is to serve reference and educational functions but is not intended to replace existing acts, regulations and ordinances. It describes ways of meeting terms and conditions that accompany permits. **The guidelines are subordinate to all existing acts, regulations, ordinances, and terms and conditions of permits.**

Document Organization

The guidelines have been organized in the same chronological order as events would normally occur in a hydrocarbon drilling program:

- Planning
- Construction
- Operation
- Abandonment and restoration.

Only those facilities immediately associated with the well-site (rig site, drilling fluid sump and campsite) are addressed. Other INAC publications describe environmental operating guidelines for roads and trails, pits and quarries that may be associated with drilling programs.

Permafrost is the major consideration for all facets of a northern Canadian well-site. The guidelines are organized to reflect this importance. Guidelines that generally pertain to both permafrost and non-permafrost conditions are outlined first. Those specific to either non-permafrost or permafrost conditions are presented separately. When appropriate, guidelines specific to some special terrain type, season or facility are identified.

Chapter 2 describes the administrative and regulatory framework within which hydrocarbon drilling programs occur in Northwest Territories and Yukon. Chapter 3 is devoted to well-site planning, Chapter 4 — construction, Chapter 5 — operation and Chapter 6 — abandonment and restoration.

The appendices include a checklist for hydrocarbon well-site management and a list of Northern Affairs Program offices and their locations in Northwest Territories and Yukon.

Northern Drilling Conditions

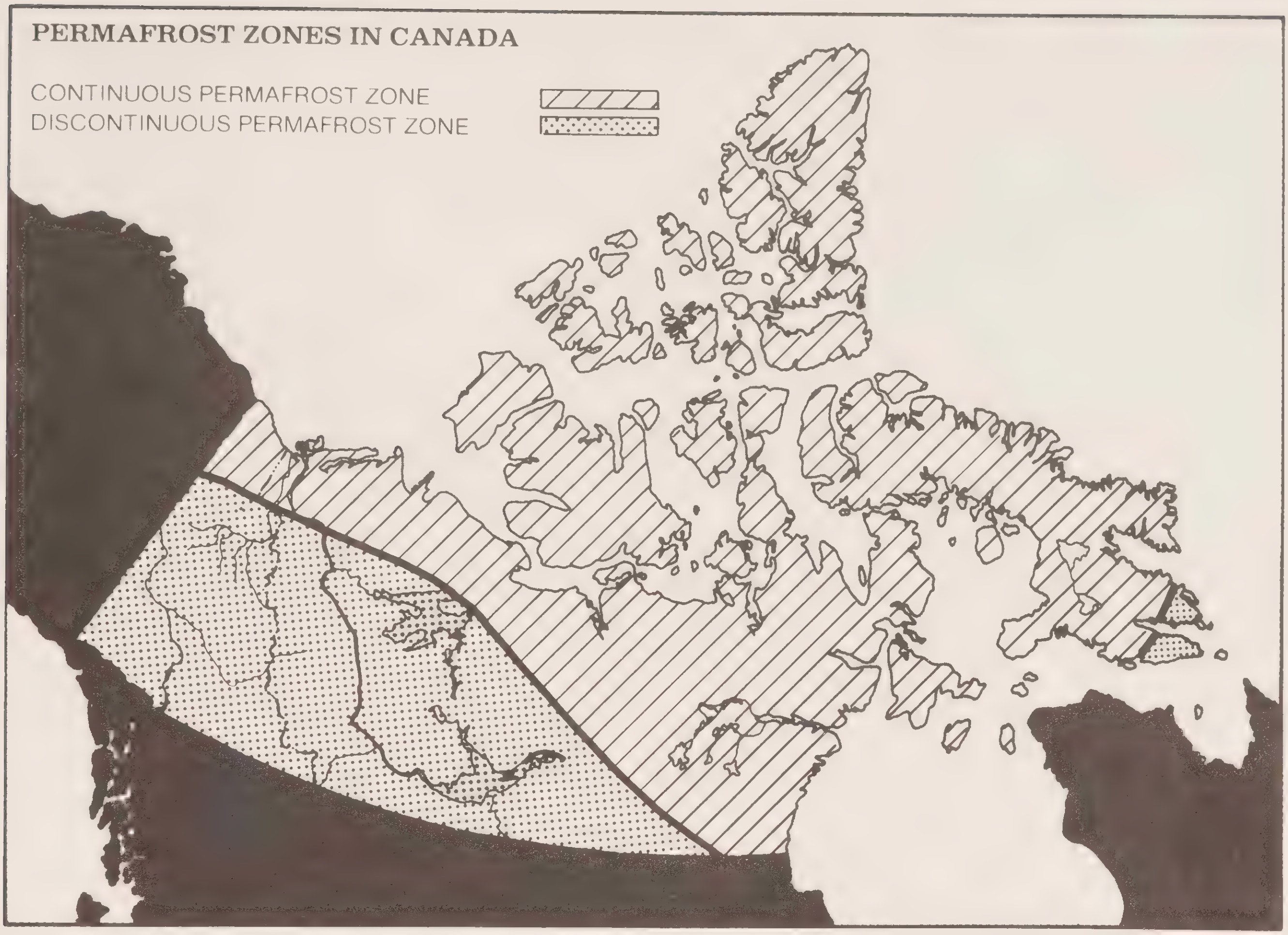
Northern Canada presents a particular and somewhat unusual range of conditions for hydrocarbon drilling. Terrain types in Northwest Territories and Yukon vary considerably from polar deserts to forests; upland tundra to deltas and wetlands. Drilling programs have been carried out in winter and in summer in all terrain types. Drilling logistics can be complicated by these varying terrain types, and when coupled with factors such as remote locations, and extremes of weather, the demand for detailed pre-planning to account for these conditions is essential.

Abandoned well-site — mountainous terrain

Mackenzie Delta wetlands, N.W.T.

Summer drill program, N.W.T. tundra

Winter drill program, N.W.T. tundra



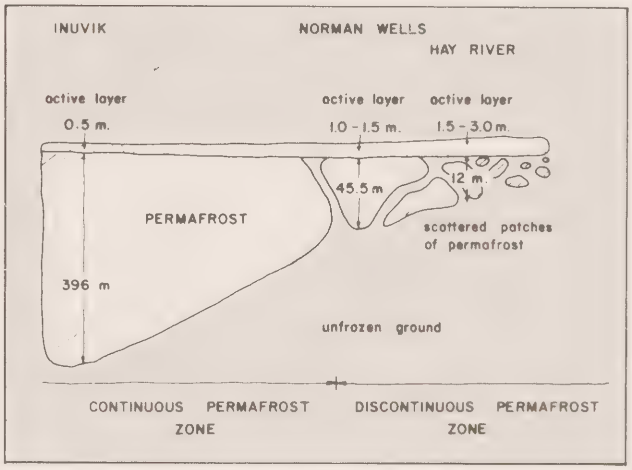
adapted from *Permafrost in Canada* by R.J.E. Brown

Permafrost

One of the most critical conditions in pre-planning a drilling program in northern Canada is the understanding and recognition of permafrost. Permafrost is ground that remains frozen through at least two consecutive winters and the intervening summer. It can consist of mineral soil, organic soil, or rock, and can be either ice-free or ice-rich. Permafrost varies in thickness from a few centimetres near the southern limit of its range to several hundred metres in the north.

A zone called the active layer overlies permafrost. It consists of soil or organic matter that freezes and thaws with the season. Active layer thicknesses vary from a few centimetres in the north of the permafrost zone to a few metres in the south.

Permafrost is found across northern Canada and is divided into the continuous and discontinuous zones. In the continuous zone, permafrost occurs under all land surfaces - active layers are thin and permafrost is thick. In the discontinuous zone, permafrost is found only under certain conditions. The typical locations of permafrost in the discontinuous zone are on north-facing slopes, within muskeg, and on shaded terrain with minimal snow cover.



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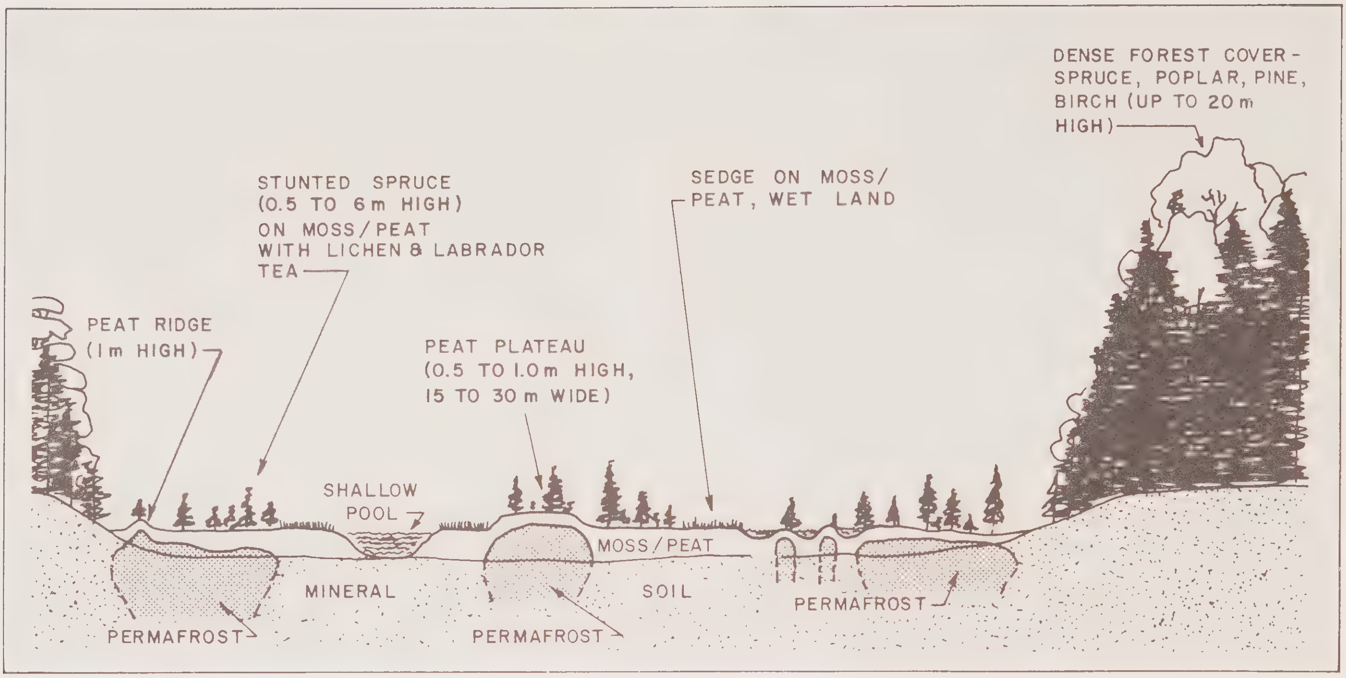

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Permafrost is sensitive to changes in ground and air temperature. It is protected from these changes by the organic mat which acts as insulation and by the shade provided to the surface by trees, shrubs and grasses. Snow is also an excellent insulator. The effect of snow on permafrost, however, can be two-fold. In the early fall, snow can insulate the ground surface from the cold and retard the penetration of frost. In late spring, snow can delay frost leaving the ground.

The insulative characteristics of peat result in a close association between permafrost and muskeg in the North. During the summer when the surface layer of peat is dry, it acts as a good insulator and preserves cold soil conditions thereby resulting in the permafrost regime. In autumn the peat becomes moist and therefore is a very poor insulator. Soils beneath the peat cool faster than surrounding soils in response to cooler autumn air temperatures.

Of special importance to hydrocarbon operators; disturbance of the insulative layer will cause permafrost to thaw. If the soil is ice-rich, then slumping, sliding and other forms of erosion may occur.

Because it acts as a conductor of heat, water greatly influences the distribution of permafrost. For instance, the permafrost table is depressed under lakes and streams (Hardy 1984).

Chapter 2

Legislative Background

Introduction

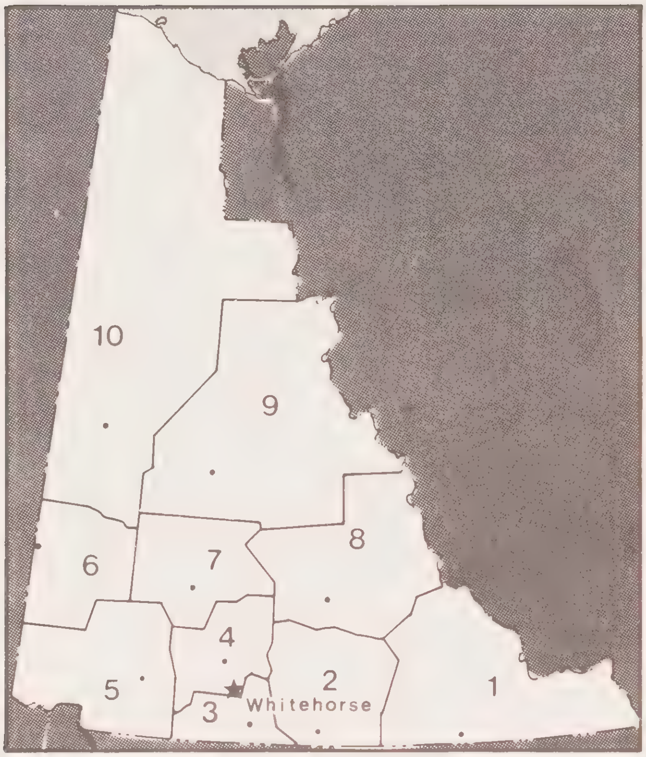
A variety of acts, regulations and territorial ordinances administered by the ministries of federal and territorial governments pertain to hydrocarbon well-sites. This section briefly describes the legislation and the relative roles of the federal and territorial governments. A more detailed explanation of government administration in Northwest Territories and Yukon is provided in "Northern Natural Resource Development: Requirements, Procedures, and Legislation" published by INAC (1981).

Government in Northern Canada

Of special importance to oil and gas industry operators in Northwest Territories and Yukon is the relationship between INAC and COGLA. COGLA is a federally created agency jointly composed of INAC and the Department of Energy, Mines and Resources (EMR). COGLA administers the Canada Oil and Gas Act and regulations pursuant to it in Northwest Territories and Yukon. At the well-site, all matters concerning the drilling operations and industrial safety are COGLA's responsibility. The Northern Affairs Program of INAC is responsible for overall environmental matters.

Almost all public land in Yukon and Northwest Territories is administered by the Government of Canada and is referred to as "territorial lands". The exception is small tracts of land around communities administered by the territorial governments and referred to as Commissioner's Lands. There are also large tracts of land privately held by native corporations.

For purposes of administration, INAC has divided Northwest Territories and Yukon into resource management areas — each with a local administrative office. Regional offices are located in Yellowknife and Whitehorse.



INAC Resource Management Areas

Northwest Territories:

1. Ft. Simpson
2. Inuvik
3. Baffin
4. Keewatin
5. Yellowknife and Arctic Islands
6. Ft. Smith

INAC Resource Management Areas

Yukon:

1. Watson Lake
2. Teslin
3. Tagish
4. Laberge
5. Haines Junction
6. Beaver Creek
7. Carmacks
8. Ross River
9. Mayo
10. Dawson

Acts and Regulations

A number of federal and territorial government laws may affect oil and gas drilling operations:

Territorial Lands Act provides the authority for administering and protecting lands under the direct control of the Minister of INAC (Territorial Lands). The following regulations are pursuant to this act:

Territorial Land Use Regulations provide regulatory control for maintaining sound environmental practices for any land use activities on Territorial Lands. These regulations require that land use permits be issued for such operations as work involving the use of heavy equipment, establishment of camps, use of explosives and clearing of lines, trails and rights-of-way.

Territorial Quarrying Regulations establish the fee schedule and procedures for extracting Crown-owned limestone, granite, slate, marble, gypsum, loam, marl, gravel, sand, clay or stone from Territorial Lands. The regulations specify permits, applications, staking and dimensions of quarries.

Territorial Timber Regulations provide a mechanism for regulating the cutting of and removal of timber from Territorial Lands.

Canada Oil and Gas Act regulates oil and gas interests on Canada Lands. Amends the former Canada Oil and Gas Production and Conservation Act.

Canada Oil and Gas Drilling Regulations pertain to exploring for, drilling for and the conserving of oil and gas on Canada Lands and the measures to ensure the safety of such operations.

Fisheries Act protects fish and fish habitat from pollution, negative alteration or impediments to fish movement.

Northern Inland Waters Act provides for regulations concerning the licensing of water use and pollution control and for establishment of comprehensive water management programs.

Yukon Blasting Ordinance and N.W.T. Explosive Use Ordinance provide a mechanism for the use and care of explosives in Canada's Territories.

Forest Protection Ordinances (YT and NWT) provides for the protection of forest from fire. Burning permits are issued by INAC pursuant to these ordinances.

Public Health Ordinance (YT and NWT) stipulates environmental health considerations pursuant to Yukon and Northwest Territories Act.

Permitting Procedures

First obtain the necessary permits

Prior to any construction activity, obtain the appropriate permits. The most important of these are the land use permit (applications are available from local INAC offices) and authority to drill a well (obtainable from COGLA).

In most cases, a Land Use Permit can be issued within 42 days of submitting the application. If, however, additional time is required to assess the application, a decision can be delayed for a period of up to 12 months.

Make sure your application includes the required information

The land use application process will progress more expeditiously providing the following guidelines are followed:

- Support the application with pertinent technical and environmental background information (e.g. terrain analysis or airphoto interpretation). These details indicate that environmental and technical concerns have been considered prior to the application being submitted.
- Include any available topographic information with the application.
- ***Include a sketch, to scale, showing the proposed facility layout. Applications for summer operations in permafrost areas must include 1 m contour intervals.***

Well-site applications for permafrost terrain must include a facility sketch with 1m contour intervals

- Include plans for fuel and hazardous waste spills, solid waste management, forest fires and reclamation.
- ***Establish early communication with Land Use officials to advise them in advance of impending applications. INAC can then advise on any special considerations.***
- Submit the application in time to account for the application processing period (42 days).

Once the land use application is submitted and accepted as being complete, it may be passed on to members of the Land Use Advisory Committee and potentially interested communities for review. Following this review, recommendations are made to the Land Use "Engineer" who may:

- issue a Land Use Permit with appropriate conditions for environmental protection, or
- refuse to issue a permit and provide the reasons therefore, or
- place the application on hold while the project is reviewed in more detail.

Read your permits carefully

Once you have received your permits, make sure you read them. The terms and conditions attached to the permits are intended as practical methods of protecting the environment and the permit holder is responsible for seeing they are adhered to. ***If, for whatever reason, circumstances prevent you from complying with a term or condition, notify your Land Use Officer and your situation will be reassessed.*** The Land Use Regulations provide a process for appealing any decision of a Land Use Inspector or Engineer.

Information requirements for completing an application for authority to drill a well are available in the publication "Drilling for Oil and Gas on Canada Lands" published by COGLA in 1984.

Chapter 3

Planning

Well-Site Selection

General

Adequate pre-planning is critical

Adequate pre-planning is critical to effective environmental management of hydrocarbon well-sites. A good rule of thumb is to establish drilling plans for the following winter season by mid-summer of the preceding season.

Conduct site evaluations in the absence of snow cover. Snow cover greatly reduces the accuracy of site inspections for the operator and land use inspectors. ***Aerial photo interpretation, surficial geology reports and the Land Use Information Series of maps are also excellent site selection tools and very useful for identifying concerns about a potential site.***

When making application for a land use permit it may not always be possible to identify the exact drilling site in either the regional or site-specific sense. Still, it is important to submit an application at an early stage and there are methods for accommodating the site-selection process within the application procedure.

If a selection is to be made at a regional scale, several specific sites may be under consideration of which one will eventually be chosen. For instance, an application may be submitted that identifies three potential sites, and the land use inspector and operator can jointly pre-inspect all three. The inspector can advise on any apparent environmental constraints associated with each. A permit for the site eventually chosen can be issued.

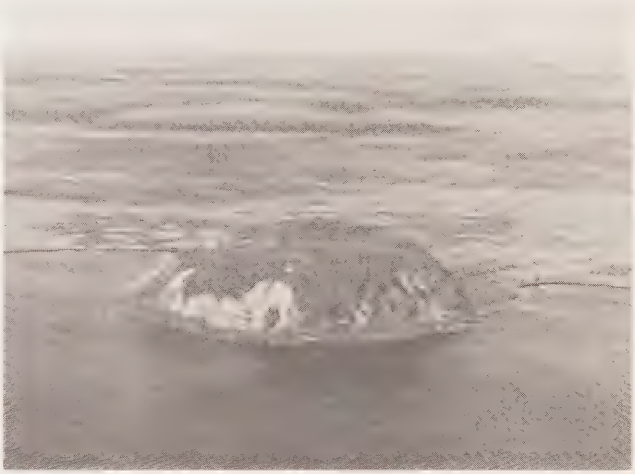
At the site-specific scale, the operator may have chosen a location but may not have delineated the exact drilling site for reason of facility layout considerations. An application can still be submitted, but it is a good rule of thumb to narrow the selection to a location where there is scope for locational adjustment to account for environmental constraints. A joint pre-inspection of the location by the land use inspector and operator can be conducted at this stage and it is possible for the inspector to comment on any apparent environmental constraints that could refine the location. In some cases it may be necessary to consider the feasibility for directional drilling.

The regional and site-specific methods outlined both facilitate commencement of the application process at an early date and help to prevent late drilling start-ups.

Site examinations should consider all factors

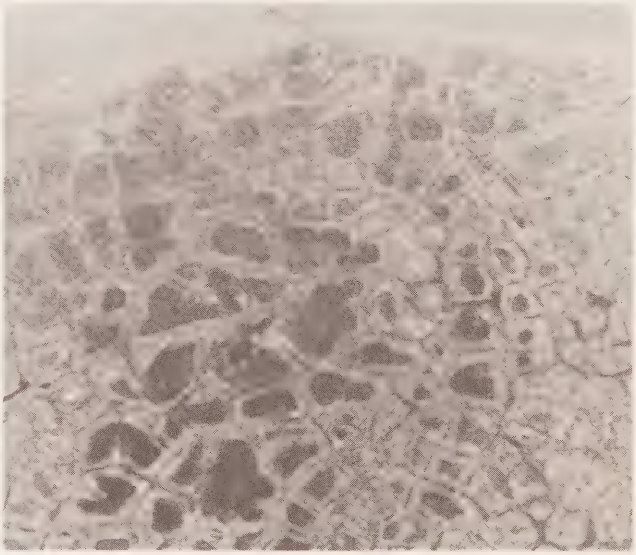
When examining a potential site, consider:

- ***presence of pingos***. Avoid locating near these;



Avoid locations immediately adjacent to pingos

- ***permafrost conditions***. Patterned ground north of the tree line indicates high ground ice content and ice wedges. These conditions especially complicate sump construction, operation and abandonment. Drilling fluids, for instance, have been known to spread from sumps along ice wedges;



Avoid locating in areas of patterned ground


High levels of ground ice create problems for sump management


Drilling fluids will migrate from abandoned sumps along ice wedges

- ***surface drainage conditions***. Avoid active stream channels and seasonal or temporary streams, high water tables, springs (especially on sidehills), and groundwater seepages;


Avoid locating in areas subject to flooding

- with all facilities constructed, it should be possible to leave a 100 m strip of undisturbed ground between the well-site boundary and water courses or water bodies;
- ***topographic conditions***. Flat or gently sloping terrain is preferable. Steeply sloping ground combined with certain soil types or permafrost can complicate sump construction and operation. Topographic highs are preferable to topographic lows because if sumps are placed in depressions, local surface runoff could be captured thereby affecting the sump's capacity;
- ***surficial soil conditions***. Some soil types either complicate or enhance drilling activities. Overview geotechnical reviews of potential sites can identify potential problems for which remedial measures may have to be developed.
- ***spatial requirements***. There must be adequate space to accommodate sumps and, if necessary as a contingency, sump enlargement;

- ***other land and resource uses in the area*** (e.g. trap-lines, critical fish and wildlife habitats, archaeological sites, traditional use areas). Examples of critical wildlife habitat include ungulate calving areas, nesting areas for colonial birds, polar bear denning areas. An initial means of confirming their presence is by referring to the Land Use Information Series of maps. Obtain information from regional wildlife officers of the Territorial governments;

SAM BARRY

Avoid locating near colonial bird nesting areas

- ***any potential for salvaging timber;***
- ***eventual restoration requirements*** (i.e. seed/ fertilizer mixes, materials handling methods, soil types and depths).

Use aerial photo interpretation

For those well-sites where a site inspection in optimum conditions is not possible, airphoto interpretation is mandatory for identifying potential problems.

Non-Permafrost

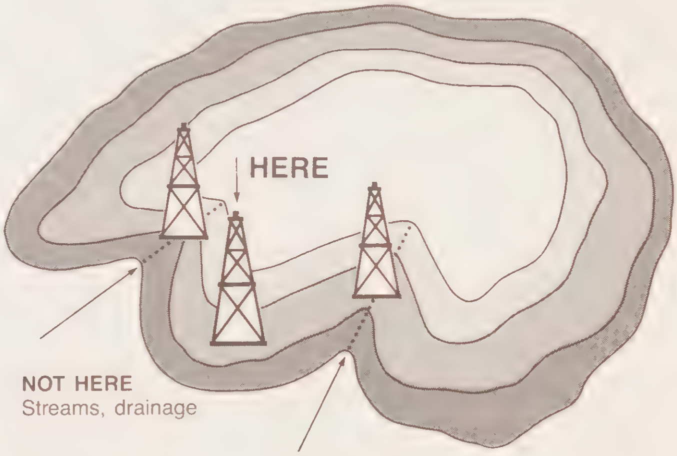
In non-permafrost areas, carefully consider the surface materials present. Permeable materials such as those found in sandhills or unfrozen peatlands require lining with some form of tarp or clay. Consolidated materials are superior for rig facility construction; the ideal location will have impervious materials.

Permafrost

In permafrost, location is critical

Avoid locating the well-site within a drainage feature. Do not locate the site downhill from perennial snow accumulation areas or snow banks. Avoid sidehill locations to the extent possible. If a potential site definitely contains permafrost, plan for water movement between the active and inactive layers and remember that drainage control is a difficult task on permafrost terrain. Drainage features that require cutting into the surface layer will only function temporarily and will create longer term erosion or thermokarst problems. Surface berms installed as drainage features have proven largely unsuccessful.

Preferred Well-site Location in Permafrost-Topographic View

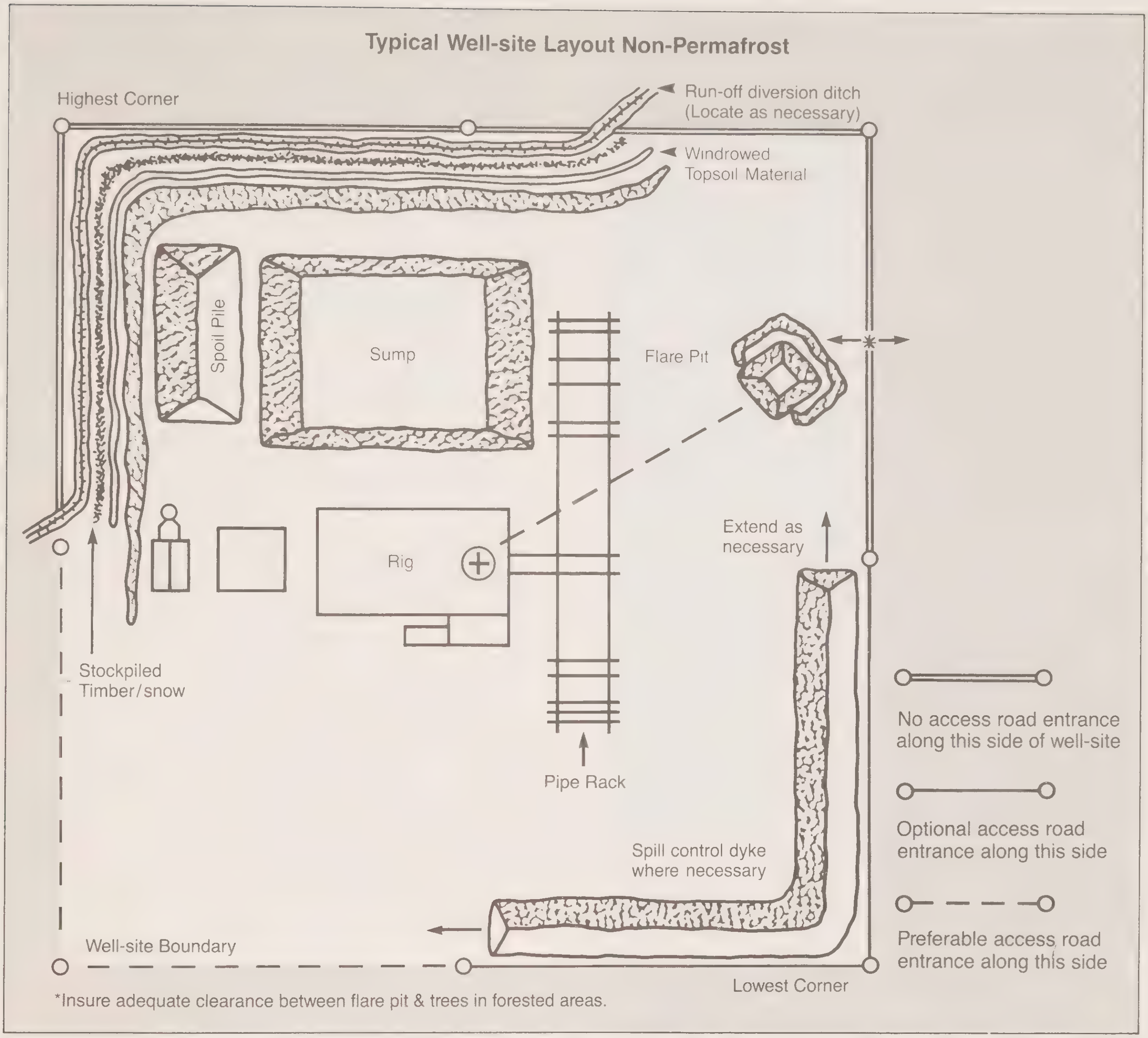


- *In permafrost, do not locate the well-site within a drainage feature*

Facilities Layout

Prepare a detailed sketch

Once a site has been selected, prepare a detailed sketch of the proposed layout. Show such detail as locations for storage of timber cover and topsoil material to be used for restoration purposes.



While the surface area utilized should be minimized, make the site of sufficient size to permit efficient materials handling and to account for accumulation of blowing snow.

The facilities layout is important for industrial safety reasons as well as environmental protection. The well-site area does not have to be square or rectangular. Shape and adjust it to account for local conditions.

Under certain conditions (topographic constraints, geotechnical conditions, water table levels) it may be preferable to have campsite, rig site and drilling fluid sump in separate locations. Sumps remote from the well-site are a viable option.

Locate the campsite and associated facilities (e.g. kitchen, sanitary waste sumps, solid waste site) a minimum of 100 m from the ordinary high water mark of any permanent waterbody or watercourse. Locate them upgrade of the well-site, on the opposite side from the flare pit and, if possible, upwind from the prevailing winds.

Leave a vegetation buffer between well-sites and water courses

Leave adequate space betweens sumps and buildings

The sanitary sumps must not be placed so close to the camp buildings that they undermine them. To mitigate against drifting snow in open tundra conditions, align the camp and other buildings so that snow will blow through.

At the well-site, designate separate areas for storage of chemicals and explosives. Make them separate from the working area and away from locations where surface waters could accumulate.

In sloping terrain, locate fuel storage caches uphill of the sump. Should a spill occur, the sump can act as a spill trap. Bulk storage sites must be more than 100 m from ordinary high water mark of waterbodies or streams.

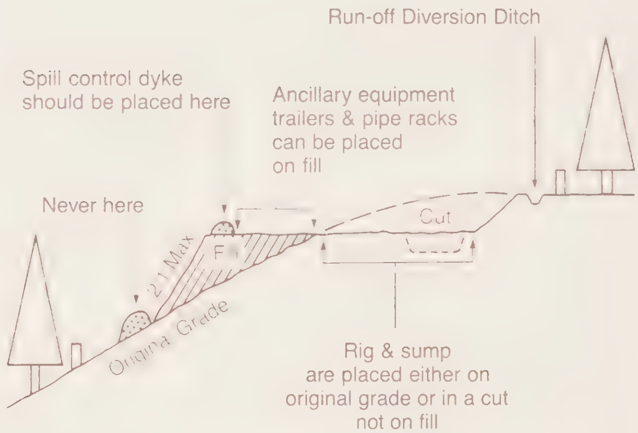
Locate any solid waste pits a minimum of 30 m back from permanent water courses or water bodies and above the elevation of the ordinary high water mark.

Locate the drilling fluid sump a minimum of 100 m from the ordinary high water mark of any permanent water body or stream. Locate it in the high side of the lease and always leave sufficient space for expansion of the original sump.

In sidehill or "cut" situations, locate the sump in the "cut" and never in the fill. Locating and constructing sidehill sumps requires caution. Examine these sites carefully for any evidence of previous instability or water seepage. Never allow drainage features such as ditches to undermine the toe of the sump in a sidehill location or it could fail.

In permafrost conditions when summer drilling is to occur, space the sump further than normal from the well-head. This measure will protect against rig movement created by possible subsidence of the sump walls.

Cross Section of Well-site on Sloping Ground Non-Permafrost



Normally, construction of the access roads to the well-site precedes construction of the well-site. When constructing the areas where the accesses enter the well-site be sure to account for the elevational changes that will occur when the well-site is contoured in preparation for erecting the rig. Cases have occurred where the access roads ended up at the top of a cut following contouring.

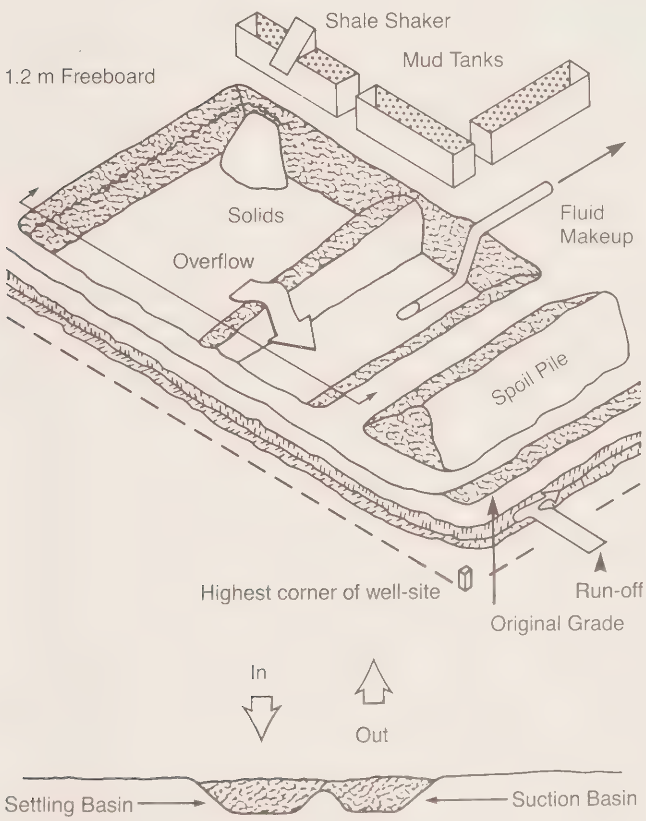
Sump Type Requirements

Decide on a circulating or non-circulating sump

Non-Permafrost

Sumps are either circulating or non-circulating. The circulating types are smaller than non-circulating and are best-suited to summer drilling programs. Their smaller volumes reduce the potential for surface disturbance. They are normally divided by a sub-surface berm that ensures that recycled drilling fluids are relatively free from solids.

Recirculating Sump — Non-Permafrost



- *Circulating sump design*
- *Summer conditions*

Permafrost

Non-circulating sumps are most often used in permafrost and winter drilling situations. Drilling fluids that enter the sump during cold temperatures freeze and limit recycling opportunities. These sumps are characteristically larger than the recirculating types and, therefore, can create more surface disturbance. To minimize this surface disturbance, excavate them deeper rather than wider.

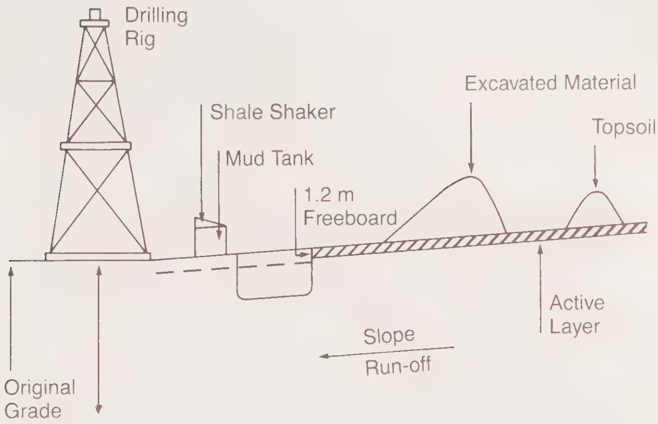
Drilling fluids freeze quickly when entering sumps in winter

Sump Size Considerations

Always maintain adequate freeboard

A standard term and condition of land use permits for well-sites is the requirement to ***maintain drilling fluid levels a minimum of 1.2 m below the level of the immediately adjacent original ground.*** The freeboard requirement is based on the desirability of maintaining the fluids below the active layer in permafrost and, therefore, at a level that will facilitate permafrost invasion of the fluids when totally contained at abandonment. Maintaining a free board also provides a safety allowance to accommodate extra fluids produced from unforeseen circumstances. In certain site-specific cases the freeboard could be increased.

Cross-section, Non-circulating Sump-Permafrost



- *A non-circulating sump design*
- *Winter conditions*

Specific formulae have been developed by the oil industry for planning the sump size. For most of these formulae, the major consideration is depth of hole. One simple formula determines that the sump should have a working volume of 4.9 barrels or 0.78 m^3 per metre of hole drilled.

In addition to this simple formula, the operator must consider:

- expected duration of the drilling program,
- possible adjustments to the target depth,
- any plans for more than one drilling season of operation,
- the types of formations to be drilled in,
- local precipitation conditions,
- presence of permafrost,
- blowing snow conditions,
- potential for intrusion by groundwater, and
- the fact that the drilling fluids can freeze.

Special Plans

Your application must include special plans

During the planning phase, develop management plans to deal with accidental spills of fuels and hazardous wastes, solid waste, reclamation and where appropriate, forest fires. These must accompany the application for the land use permit.

Fuel and Hazardous Goods

Development of a contingency plan for various emergencies including fuels and hazardous materials spills is a regulatory requirement when applying to COGLA for an authority to drill. COGLA requires exploration companies to carry insurance policies to cover the costs arising from damages from spills.

The land use application submitted to the Northern Affairs Program of INAC must include types and quantities of fuels and goods to be used, persons and telephone numbers of persons to be contacted in the event of a spill, a company response organization and reporting procedure, equipment to be used for clean-up and a clean-up plan.

Solid Waste Plan

The solid waste plan should include a description of the solid wastes, on-site burial methods to account for such factors as permafrost, any plans for hauling solid wastes from the site and off-site disposal methods and locations.

Forest Fires

Even though preventative measures are taken at the well-site, forest fires could accidentally occur from the operation. An inventory of emergency fire fighting equipment must be kept at the well-site for such eventualities.

A fire contingency plan should describe who to call in an emergency and the responsibilities of the drilling crew. Any forest fires must be immediately reported to local INAC offices.

Reclamation

Make sure that the reclamation plan describes eventual end land use, recontouring plans, stabilization means when applicable, erosion control measures to be employed and their locations, seed and fertilizer mixes to be used and topsoil management techniques when applicable.

For locations with only winter access, reclamation equipment and materials should be hauled to the site and stockpiled before spring break-up.

Chapter 4

Construction

Site Preparation

Stick to a game plan

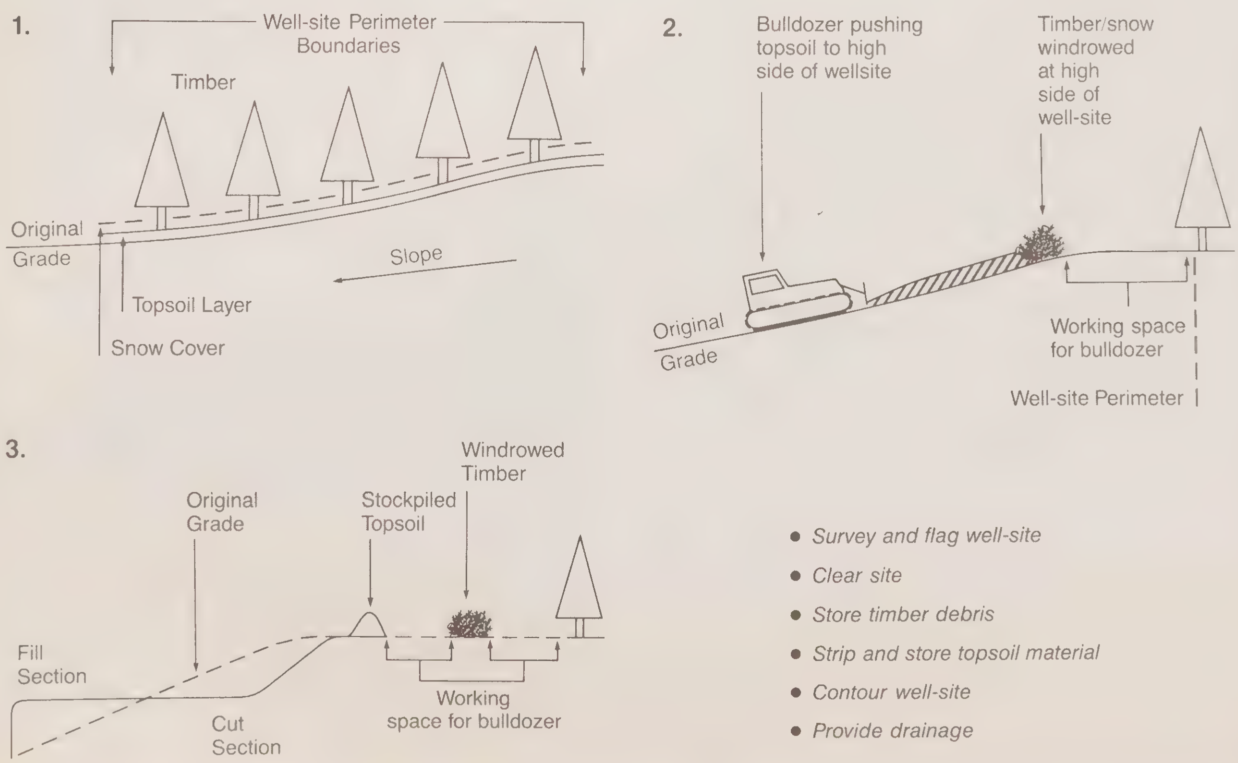
General

An organized and disciplined approach to construction will minimize environmental problems. Closely follow the details of the well-site sketch plan prepared during the planning phase, but first survey and flag the well-site area to assure minimum surface disturbance when the site is cleared.

In treed areas, clear the site as the next step. Either partially or totally dispose of the timber cover. Salvage of valuable timber is encouraged where appropriate.

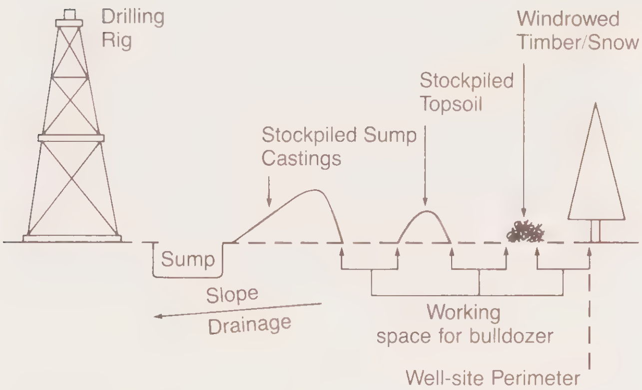
Windrow timber cover at the well-site edge

Site Preparation — Non-Permafrost Sequence



If partial disposal is intended, windrow the timber on the high side of the clearing. Placement here simplifies future restoration activities as the material is more easily spread downhill over the well-site. If off-site erosion is a potential problem, windrow the timber at the lowside of the lease. In all cases, ***leave sufficient space between the windrows and clearing edge to allow bulldozers a working space for respreading the debris at abandonment***.

Well-site Surface Materials Handling/Storage



If the timber cover is to be totally disposed of by burning during a fire season, secure a burning permit from the district INAC offices before burning.

Some site contouring is normally required so that the site can accommodate the rig, outbuildings and drilling fluid sump. In non-permafrost areas, this may require some cutting and filling of surface materials and in permafrost areas levelling by piling and compacting snow or any available granular materials.

Non-Permafrost

Strip and store surface soils separately

Following timber clearing, clear snow from the well-site and store it in a location where it cannot contaminate stockpiled topsoils. ***Prior to making cuts, strip surface soils or the organic layer from the area to be excavated and store or windrow them in a convenient location.*** Storage on the high side of the lease will simplify respreading it. Preserve a working space sufficient for a bulldozer between the topsoils and windrowed timber. Salvage of the organic soils enhances reclamation potential, especially the difficult to reclaim alpine and subalpine areas.

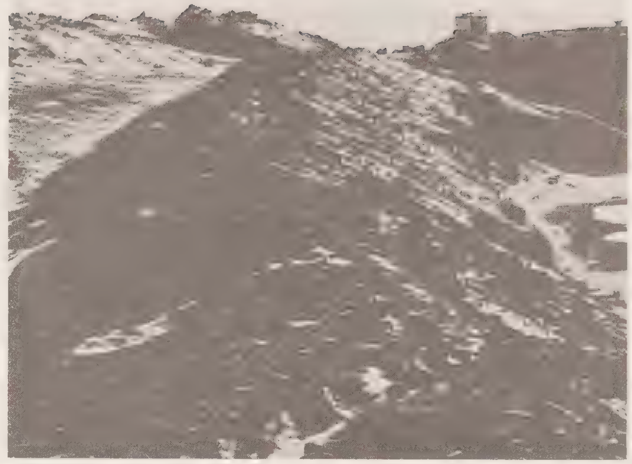
Store organic layer for future use

When the well-site has been contoured to the desired specifications, construct drainage facilities around the perimeter. These are intended to keep the well-site dry, prevent surface waters from invading the drilling fluid and camp sumps, and minimize hazards from fuel spills at the well-site.

The drainage facilities can include interceptor ditches or berms on the high side of the lease, dykes or berms at the low side of the lease.

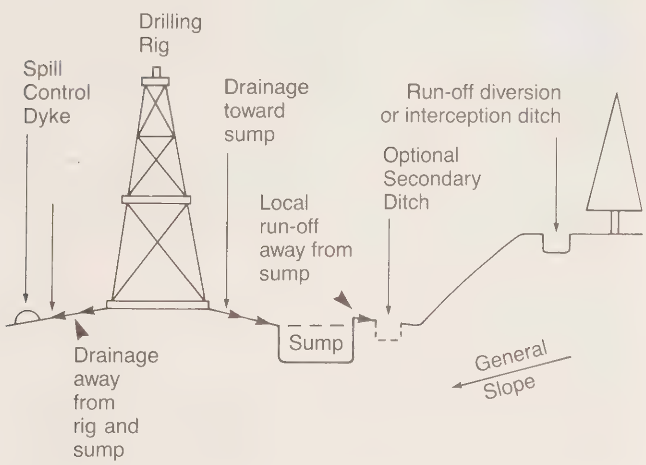
Interceptor ditch to keep well-site drained

Berm protects sidehill sump from surface water intrusion



Berms can provide drainage in permafrost areas

Non-Permafrost Drainage Features at Well-site



Permafrost

Do not disturb the surface layer in permafrost

In permafrost areas, do not disturb the surface unless the area requires excavation for sump construction or some other reason. Thermokarst conditions could result. There is no need to strip snow from the site. It can be piled and compacted to level the lease site and protect the surface mat. ***Only in extraordinary cases (where cuts are absolutely necessary) should the surface layer be disturbed.***

With the exception of granular berms, surface drainage facilities such as interceptor ditches cannot be constructed in a permafrost site.

Drilling Fluid Sump

Construct the sump systematically

General

The drilling fluid sump is the first facility to be excavated following contouring of the well-site area. The locations of the sump and spoil pile should be clearly flagged prior to activating heavy equipment. ***Snow cover must first be stripped from the area to be excavated and segregated from any existing topsoil stockpiles***. Sumps backfilled with snow-contaminated material can later subside allowing abandoned drilling fluids to escape into the environment.

Confine machinery strictly to the excavation area to minimize terrain disturbance — especially in permafrost areas.

To facilitate later backfilling, stockpile material excavated from the sump on the high side on sloping terrain.

Non-Permafrost

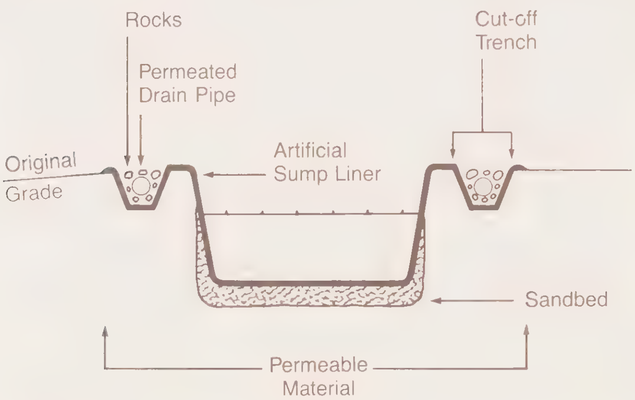
Some sump construction procedures are specific to non-permafrost areas. If abandonment plans include disposing of the drilling fluids by way of the trenching method, then place the excavated materials so that they will not interfere with constructing the trenches.

Only in non-permafrost areas can the major consideration of drainage be addressed with constructed facilities. If the sump is remote from the well-site then construct drainage features around the sump clearing to divert surface run-off away from it. Even when the sump is located on the well-site consider supplementing drainage facilities around the well-site perimeter with berms immediately around the sump.

If there is no alternative but to construct the sump in a pervious material, line it with either an artificial liner or clay.

Line dykes in pervious materials

Cross Section of Artificial Liner in Drilling Sump



Rig Area

Preserve the rig foundation

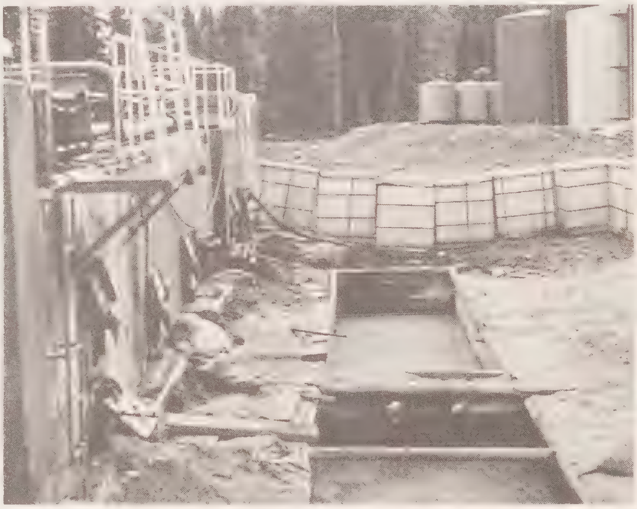
General

In all terrain types the major objective in construction of the drilling rig area is preservation of the rig foundation. Special measures are required for unstable areas or permafrost areas where summer drilling will occur.

Protect the rig foundation from rig wash residue. ***If the pad is constructed of compacted snow overlain by rig matting, place plastic sheets beneath the rig matting to assure that the wash is directed towards the cellar.*** Construct the cellar so that rig wash fluids are captured in a sump separate from the drilling fluids.

Non-Permafrost

For summer operations or winter operations where the foundation conditions are unstable, use granular or clay materials where they are available. Their use will counteract unstable surface conditions presented by terrain types such as muskeg. If surface material conditions or spatial requirements preclude construction of a sump on the immediate well-site, then embed catchment tanks adjacent to the rig pad to receive the drilling fluids. Without these, the side walls of temporary catch pits can erode and undermine the rig foundations.



Embed catch tanks to receive drilling fluids

Some surface materials will waste if imbedded catch tanks are not provided

Permafrost

Consider the permafrost preservation methods available

In permafrost, the primary objective is to protect the surface from disturbance. This will help to prevent permafrost from thawing and therefore protect the integrity of the well site facilities and structures.

Protect the surface from disturbance by one of several methods:

- constructing a pad of piled and compacted snow,
- constructing gravel pads,
- constructing platforms on pilings,
- constructing pads from artificial insulation material such as expanded polystyrene,
- some combination of any of these.

In permafrost, construct a pad of granular material overlain with rig matting

A combination of pilings and platforms functions well in some permafrost areas

Providing that the operation is restricted to winter, construction of a granular pad is unnecessary and will result in additional surface disturbance.

If granular material is to be the sole source of padding over permafrost, pile it 2 m thick to assure effective functioning. This thickness can be reduced if artificial sources of insulation are incorporated into the facility. At abandonment, the granular material can be used for capping the drilling fluid and camp sumps.

A variation of the simple gravel pad involves laying stringers over the pad and resting rig matting over the stringers. This permits air to freely circulate beneath the matting and reduces the amount of granular material required. This can be of particular importance in areas where granular materials are in short supply.

In cases where platforms on pilings are to be used, the pilings should be placed with the butt ends down, in pre-drilled holes at a depth of at least 3 times the depth of the active layer. If there is a risk of thaw during setting of the pilings then sawdust should be spread between them.

Artificial insulators have been successfully used in the arctic islands. One such method involves use of a wafer constructed of aluminium-backed expanded polystyrene overlain with plastic polythene and rig matting. Exercise caution when selecting plastics and foams as hydrocarbons will dissolve some of them. In addition, at abandonment, the artificial material has to be removed. Some operators re-use it.

All of the above methods will effectively preserve permafrost conditions when utilized in the appropriate circumstances.

Fuel Storage Facilities

Contain fuel spills

To contain fuel spills, dyke the area surrounding stationary fuel containers that have a capacity of greater than 4000 l. Line the depression bottom and dyke with impermeable material. The volume of the dyked area should be 10 percent greater than the capacity of the largest fuel container.

Line fuel storage dykes and floors with impermeable material

Camp Site

Depending on terrain type and local conditions, similar construction procedures as were used for the overall well-site apply. For summer drill programs it is important to treat permafrost conditions with measures similar to those used for rig site.

Chapter 5

Operation

This chapter describes operational practices for waste management, handling of fuels and hazardous goods, terrain disturbance prevention, use of drilling fluids and rig wash materials, drilling fluid sump management, and fish and wildlife protection.

Waste Management

Waste management at a hydrocarbon well-site involves both solid (combustible and non-combustible) wastes and sanitary wastes.

Solid Waste

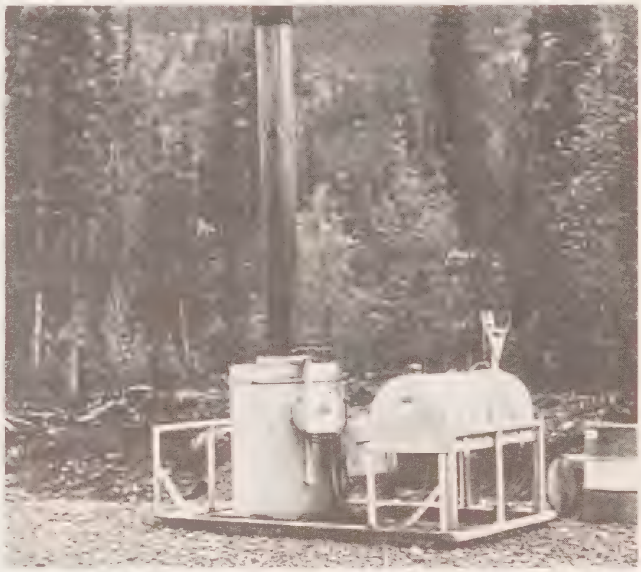
Solid waste management is a continual undertaking

The primary guidelines for solid waste management are:

- segregate combustibles from non-combustibles,
- store kitchen wastes so as not to attract problem wildlife,
- incinerate camp wastes daily,
- maintain a suitable container, such as an old dump truck box, at the rig site for incinerating combustible rig wastes,
- dispose of incinerator residue by burial or removal from site,
- either progressively bury or store non-combustible solid wastes for removal at abandonment.

Incinerate camp garbage regularly

All well-sites must be equipped with a forced air, fuel-fired incinerator. As a fire prevention measure the stack must be equipped with a spark arrestor. These incinerators effectively deter wildlife from being attracted to the well-sites by food smells.



Well-site camps must be equipped with a fuel-fired, forced air incinerator

The preferred method of managing non-combustible waste products is to back haul them to southern Canada for recycling or to approved disposal sites. In some cases, the land use engineer may authorize burial on the well-site area. Do not bury solid wastes within the active layer in permafrost areas. They will frost-jack to the surface after abandonment.

Do not deposit solid wastes in the flarepit or sump

Solid wastes should never be disposed of in the flarepit during the operational drilling stage of the well. Neither should they be disposed of in the drilling fluid sump if it is the recirculating type or is to be decanted.

Sanitary Wastes

All sanitary wastes must be disposed of and contained in a camp sump separate from the drilling fluid sump. There must be a freeboard maintained in these sumps in the same way as there is for drilling fluid sumps.

Hazardous Goods/Fuel Handling

Handle and store hazardous goods and fuels with caution

Maintain an inventory of the types and quantities of hazardous goods and fuels on the well-site. To facilitate this make a site map depicting storage locations. ***Segregate explosives from chemicals***, store fuel drums and hazardous goods containers in an upright position. Clearly identify the hazardous goods storage area and mark fuel lines. Keep the area clear of debris and snow to ease routine inspections and minimize the risk of equipment hitting stored goods.

Clearly mark well-site facilities

Monitor the goods storage area

Monitoring is a critical aspect of fuel and hazardous goods handling. Appoint someone to monitor hazardous good storage and use, and to routinely inspect for leaks from storage containers. Closely supervise all bulk handling operations of hazardous goods.

Fuel storage methods are of special importance. Bladders, due to quality control and environmental conditions (i.e. lack of sand for bedding material), have a history of failure. Their use is discouraged. At sites that occur in critical wildlife areas or upstream of community water supplies, and where a fuel cache of greater than 44,803 l capacity is maintained, operators may be required to keep on site an empty fuel tank so in the event of a spill, spilled fuels can be pumped into it.

Clean up spills immediately

Should spills of hazardous goods or fuels occur, report them immediately and clean them up in accordance with the approved spill contingency plan.

Fuel Bladders are discouraged

Clean-up spilled goods immediately

Terrain Disturbance Management

Minimize terrain disturbance

The most effective means of reducing surface disturbance is to restrict the operation to periods when the ground is frozen and snow covered. Severe surface disturbance can result from operating machinery before the ground is adequately frozen — especially in permafrost.

Severe surface disturbance from ill-timed machinery operation in permafrost

Brief rig personnel on the importance of reducing surface disturbance. ***Restrict the surface movement of all support machinery to the well-site.***

Drilling Fluids, Rig Wash

General

Know the properties of the muds on site

Well-site personnel must be familiar with the properties of the mud types available and ***only use drilling additives of chemically known composition.*** This is especially important should abandonment require decanting. For future reference, keep a record of the quantities and types of mud additives used in case post-abandonment leakage problems occur that require pollution mitigation measures. This information will also be required by the Northern Affairs Program of INAC in support of applications to decant.

The least toxic drilling mud additives are safest to use. Those that have compounds composed primarily of heavy metals are least desirable while simple beneficiated bentonite systems or bentonite chemicals are easiest to flocculate and chemically treat.

Segregate rig wash and drilling fluids

To the extent possible, segregate rig wash residue from the drilling fluid sump. Rig wash often contains hydrocarbons that complicate the disposal process. The extra fluids represented by the rig wash can create drilling fluid sump capacity problems. Some of these difficulties can be reduced by using steam rather than rig washes with detergents, using biodegradable rig wash, or, by diverting wash fluid from the cellar with a drain mechanism.

Permafrost

Avoid using high salt content drilling fluids

In permafrost conditions or for winter drilling programs where the method of sump abandonment is to be total containment, avoid using fluids with high salt content. Do not dispose of surplus salts in the drilling fluid sump at abandonment. They retard the freezing process and can thaw sump walls with high ice content.

Drilling Fluid Sump Management

General

Monitor sump conditions regularly

Monitor the sump regularly in order that any required corrective measures can be immediately implemented. Indicators of potential problems are cracks in any surrounding berms, integrity of surface drainage facilities around remote sumps, lateral cracking in sidehill locations, and fluid levels.

Prevent snow from accumulating in the sump by using snow fences.

Lateral fracturing in fill sections can indicate instability

Deal with apparent sump problems expeditiously

Despite planning, and as a result of unforeseen circumstances (extra depth drilling, breakdown of drainage features, inclement weather) the original drilling fluid sump may prove too small for the amount of fluid. This can be critical in sidehill locations. The sump may fail if it is overloaded and subsequently release untreated toxic material into the environment.

Sumps constructed in sidehill locations require special care

To deal with such an eventuality, first, advise the land use inspector of the situation. There are three options for dealing with the situation:

- suspend drilling.
- construct a supplementary sump or enlarge the existing one.
- decant fluids from the sump.

The selected option must have approval of the responsible regulatory authority.

Drilling conditions sometimes necessitate construction of a supplementary sump

Supplementary Sump

Construct these either immediately adjacent to the existing sump or in a location remote from it.

To construct a supplementary sump, simply excavate the new one next to the original but retain a wall between the two. Next, dig a ditch to connect the two sumps. A backhoe is the best machine for this purpose. In winter conditions, it is possible to push frozen materials with a bulldozer, across and into the new sump.

It may be necessary to adapt the existing drainage facilities to the newly constructed sump to assure that no surface drainage intrudes. For supplementary sumps that are constructed remote from the original, the same siting criteria and construction chronology as for the original sump apply.

Drilling fluids can be pumped or trucked to the remote sump. If trucked, a practical access for the vacuum truck must be constructed. It may be necessary in winter to break-up and load frozen material from the original sump and then truck it to the remote site.

Remote sump with vacuum truck access

Decant

Applications to INAC to decant sump fluids will only be considered in special circumstances and only for treated fluids

Applications to decant must include:

- a schematic diagram of the well-site location;
- full name of the well, well number and geographic coordinates;
- length, width and depth of rig sump;
- volume of fluid contained in the rig fluid sump;
- name and address of the land use operator and sump clean-up contractor;
- a description of the receiving environment-terrestrial and aquatic (i.e. drainage patterns, vegetation cover, soil properties);
- a description of the treatment process (flocculant type) used;
- a description of the mud additives, by quantity, used in the drilling process;
- results of water quality sampling tests (descriptions of the sampling methods are available from district INAC offices); and
- results of bioassay tests (descriptions of how these are to be conducted are available from regional INAC offices).

In order to decant, the following values must not be exceeded by the sump fluids:

- Chloride content — 1000 mg/L
- Sulphate content — 2000 mg/L
- Total dissolved solids — 4000 mg/L
- pH 5.5 — 8.5

In addition, only clear and treated fluids may be decanted and then only to the land surface a minimum of 100 meters from any stream course or water body. Decanting must be done in a manner such that no ponding or visible runoff occurs on the land surface where the sump fluids are spread.

The perimeter of the area for which the decant has been applied must be staked and flagged. Stakes must be at 50 m intervals. Any dilution of the existing fluids must be done in a manner whereby the dilution or volumes can be easily measured. The maximum chloride application to the land may not exceed 168 kg of chloride per hectare. The INAC land use inspector must be notified 24 hours before any sump water testing or decanting occurs. The treated sump fluids must be tested 2 weeks before the decanting is to occur. Operators who are considering applying to decant should consider that:

- they are responsible for having commercial laboratories conduct the water quality laboratory analyses and bioassays in accordance with INAC guidelines;
- they must expedite samples to commercial laboratories for analysis;
- they are responsible for assuring that appropriate fluid sampling equipment is on site and that a designated person on site is familiar with its use;
- as a contingency measure, they have on site a supply of flocculant in sufficient quantities to treat additives in the drilling fluids; and
- they closely monitor sump fluid levels so that appropriate action can be taken as soon as possible. The bioassay test, for example takes 96 hours.

Multi-Season Sump Management

Avoid leaving sumps open over summer

In both permafrost and non permafrost terrain, surface disturbance is more pronounced from summer sumps and those used for a second winter drilling season. For instance, the sidewalls slough as the ground ice melts out in permafrost terrain. Attempts to prevent melt out by lining the sump walls with insulating materials have been generally unsuccessful. If a winter drilling program is to extend into summer, it may be preferable to backfill the original winter sump and construct a smaller recirculating type for summer.

Sumps left open over a summer season tend to slough

Insulating sump sidewalls in permafrost rarely works

Multi-Season Well-site Management

Consider your options early

Not all winter drilling programs progress on schedule. ***When it becomes apparent that drilling will not be completed in one winter season or that it will overlap into summer, make contingency preparations.***

They could include expediting additional supplies while the winter access can still be travelled, converting winter access to summer, making plans for disposal of or carry over of drilling fluids in the rig sump and improving the rig foundation. Approximately mid-March, determine if the well-site can be converted to a summer program or should be moth-balled until the next drilling winter season. Plan winter drilling programs around predicted dates of spring break-up for the region. ***Schedule adequate time for demobilization.***

Fish and Wildlife Protection

Avoid creating wildlife problems

Certain well-site operating measures will minimize impacts on fish and wildlife resources:

Do not feed wildlife

- ***Incinerate kitchen wastes daily*** and prior to their incineration store them in a wire kitchen enclosure. Foodstuffs entering the camp should also be stored in the kitchen enclosure.
- ***Do not feed wildlife.***
- Do not harass wildlife with supply aircraft or other transportation equipment.
- Over critical wildlife areas, aircraft should maintain a ceiling of 300 m.

As a safety measure, ***keep one gun in camp*** and store it in an area ***for emergency use only.*** Familiarize several people with its location and method of use.

Chapter 6

Abandonment and Restoration

Waste Disposal

Solid Wastes

Solid waste burial can be more complex than it looks

Remove all non-combustible solid wastes from the well-site unless on site burial in a waste pit has been previously authorized. Before backfilling the pit, compact the wastes as a measure to deter post-abandonment subsidence. In all terrain types, be sure to cap the pit to account for possible subsidence.

Disposal of non-combustible solid wastes in permafrost is more complex. The objective should be to preserve the local permafrost regime and prevent thermokarst conditions from establishing:

- Selection of a burial site in granular material rather than in fine-grained soils provides an extra measure of protection.
- The waste pit should be excavated and backfilled in winter only.
- The floor of the pit must be well below the active layer and all wastes disposed of below this layer to deter them from frost-jacking to the surface.
- To account for subsidence and to encourage permafrost invasion of the buried wastes, cap the pit, preferably with granular material.

Drilling Fluid Sump and Camp Sump Abandonment

General

Proper abandonment of sumps is of critical importance

Use abandonment procedures that will minimize the potential for subsidence. Most long-term terrain disturbance and pollution problems associated with abandoned well-sites result from improper sump abandonment procedures and subsequent subsidence or erosion.

Post abandonment sump subsidence is a common problem

Drilling Fluid Disposal

Determine an appropriate disposal method

The acceptable methods of disposing of drilling fluids are:

- downhole disposal (when feasible),
- squeeze method,
- trenching method,
- total containment, and
- decant.

Of these methods, downhole disposal and decant are applicable in all terrain types while the squeezing, trenching methods apply only to non-permafrost areas. Total containment is best applied in permafrost conditions.

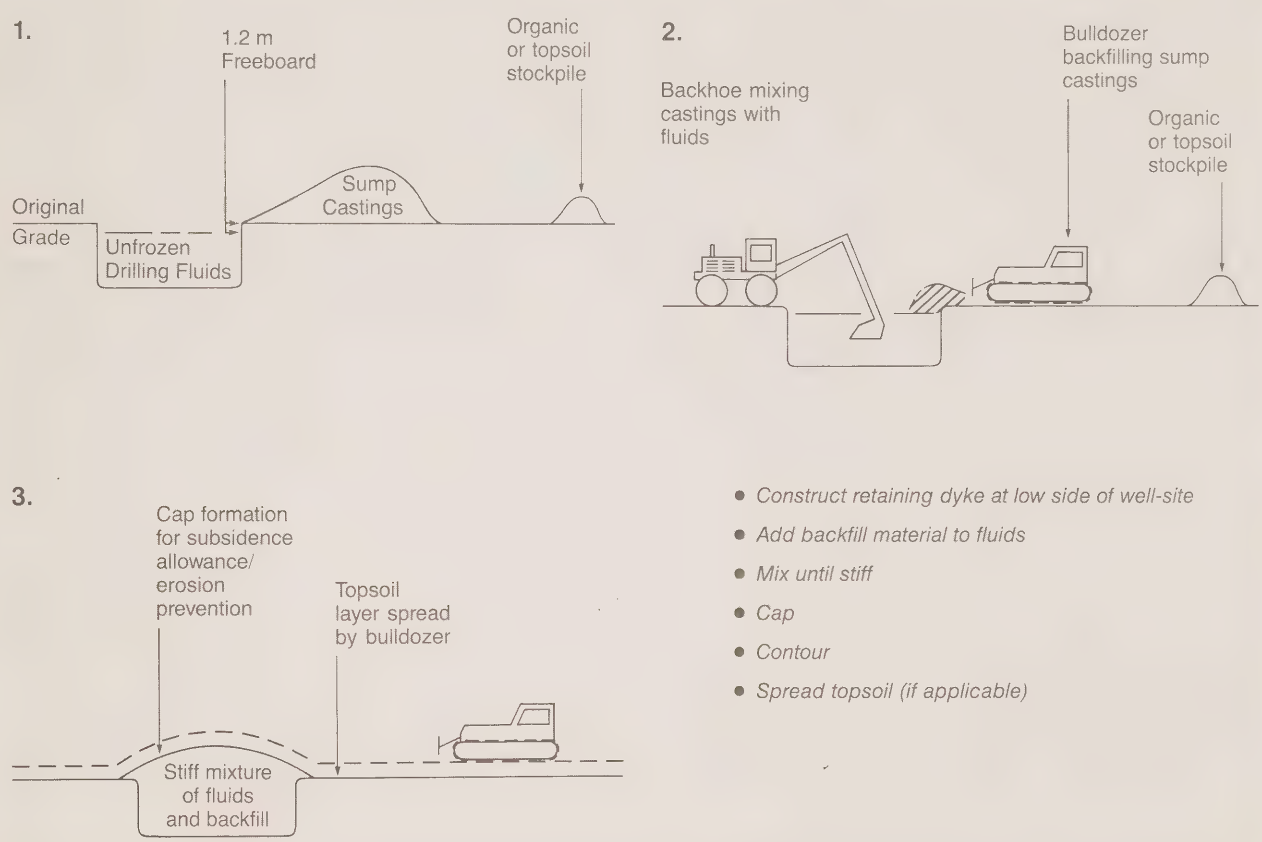
Downhole Disposal

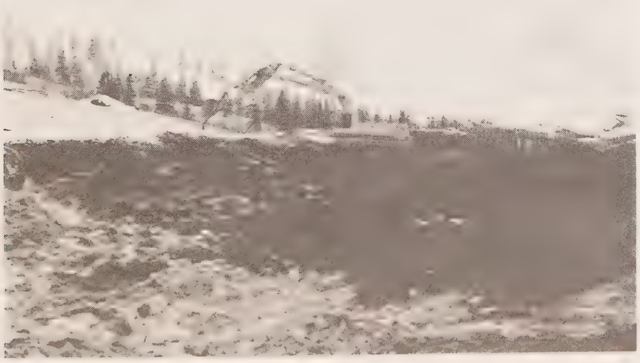
"Downhole" disposal can be used for dry or successful holes but requires approval by COGLA. Drilling fluids can be disposed of in this manner when and where there is no potential for affecting a hydrocarbon producing formation, or jeopardizing any subsurface potable well horizon.

Squeeze Method

The squeeze method involves disposing of and containing drilling fluids totally on the well-site. Initially, construct a dyke on the lower side of the well-site to capture any drilling fluids displaced during backfilling from the sump. Next, gradually add backfill material to the fluids. At first these will become a soupy substance and, later, as more material is added and mixed in, a stiffer substance. Mixing the substance with a backhoe bucket is particularly effective. The stiffer the mixture, the better the foundation for the eventual cap.

Non-Permafrost Modified Squeeze Technique — Drilling Fluid Disposal





A backhoe simplifies sump abandonment

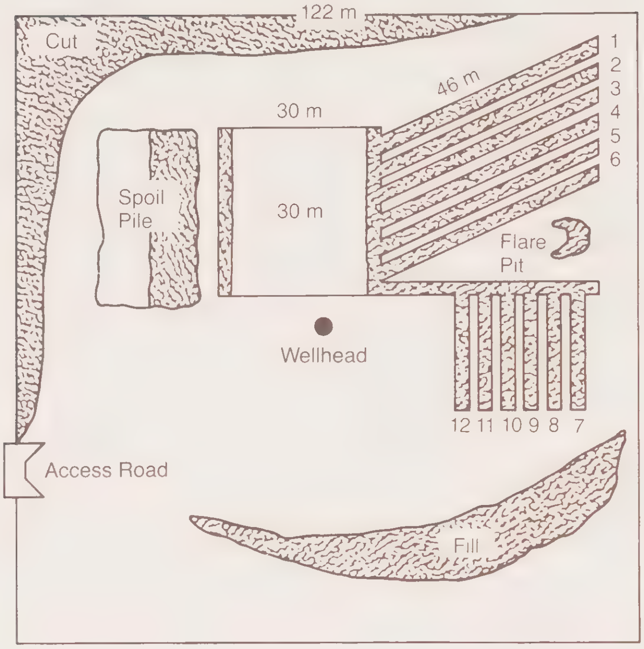
Once the mixture has reached a stiff consistency, cap and contour the sump.

Trenching Method

This method has been used mainly for situations involving large quantities of drilling fluids. They are disposed of within the confines of the original well-site. Excavate a series of baffled, parallel trenches in the cutside of the well-site adjacent to the sump. Depending on volume of fluid to be disposed of, vary the trench depths.

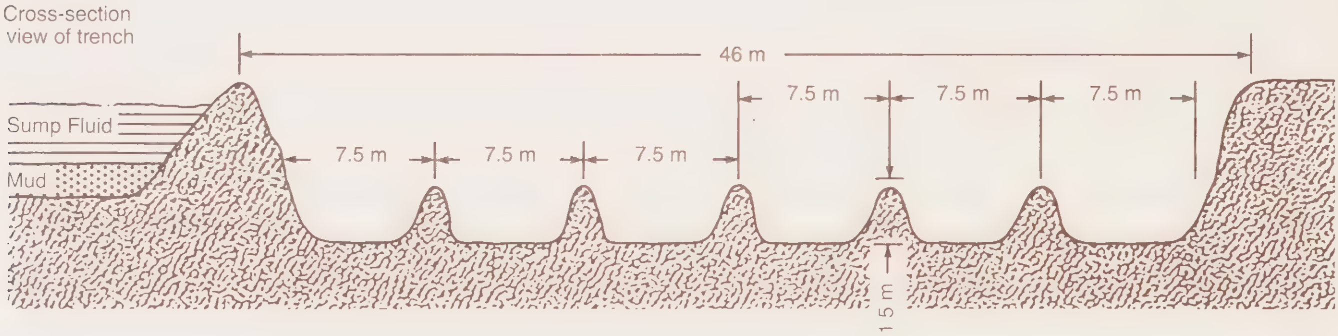
After the first trench has been completely excavated, open the baffle adjacent to the sump to allow fluids to enter this trench only to a depth of 1.5 m or not higher than the top of the bottom baffle.

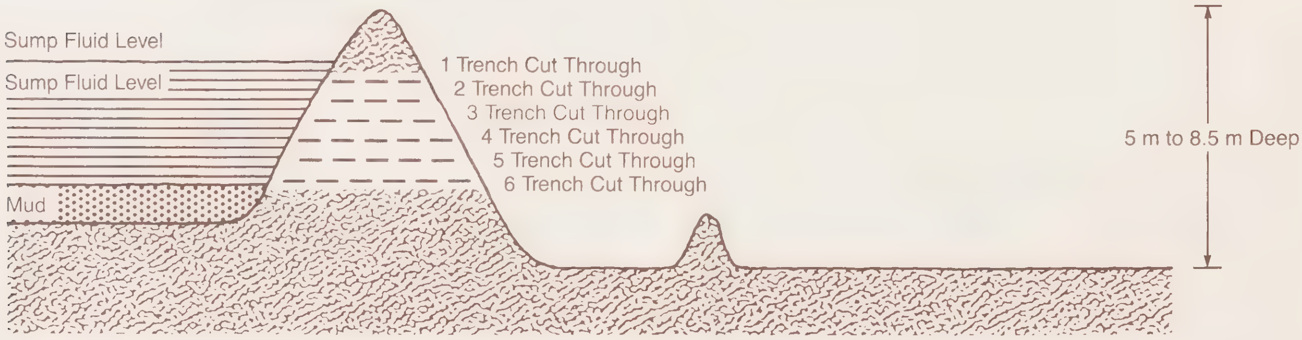
Cross-Section of Fluid Disposal by Trenching Method



Excavate trench No. 2 approximately 2 m from trench No. 1 and cast excavated soil directly into trench No. 1. After trench No. 2 has been excavated and trench No. 1 is filled, it will become evident if more or less fluid can be contained in the ensuing trenches depending on the absorption capabilities of the soil. With other equipment begin filling in the main sump and squeezing fluids toward the trenching area. As the containment and squeezing process progresses, heavier, less viscous fluids and drilling mud will become evident. If there is sufficient space remaining in the trenching area, contain fluids in the same manner as outlined previously. If, however, the area is limited, excavate a series of trench laterals starting at the last trench extremity and repeating the same procedure as outlined earlier.

When all the sump fluids have been contained, have other equipment compact the trenched area and contour the well-site. Minimum compaction of soil in the trenches should be required. Fill and landscape when the soil has finally settled.





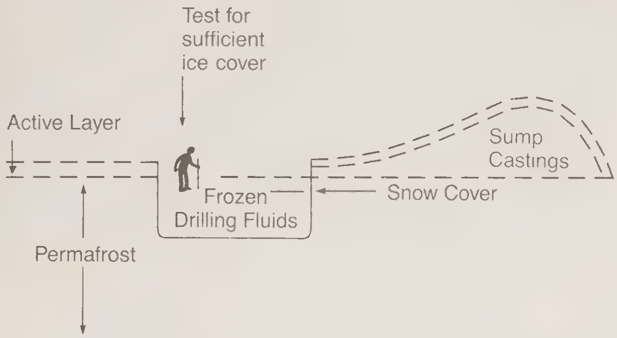
- *Excavate trench series*
- *Progressively open baffles and backfill trenches*
- *Compact trenches area*
- *Contour*
- *Spread topsoil*

Total Containment

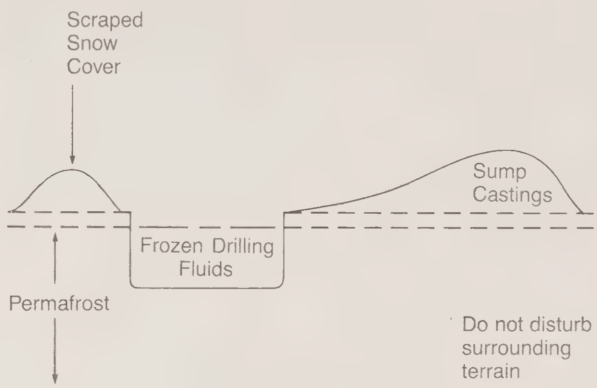
Total containment has been the preferred disposal method in northern Canada — especially in permafrost areas. It is usually a term and condition of all land use permits for well-sites. The system involves confining drilling fluids within the sump. This method encourages invasion of the drilling fluids by permafrost.

Total Containment Steps

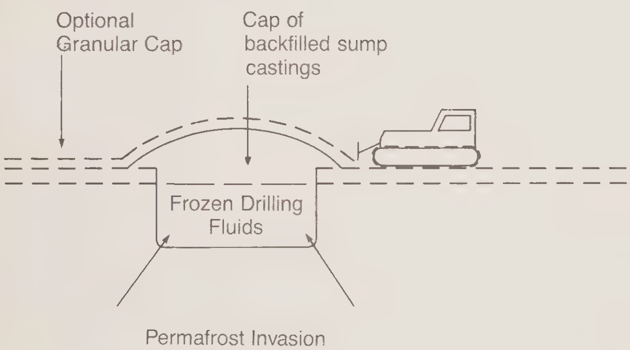
1. *Test Ice*



2. *Remove Snow from Sump and Castings*



3. *Backfill*



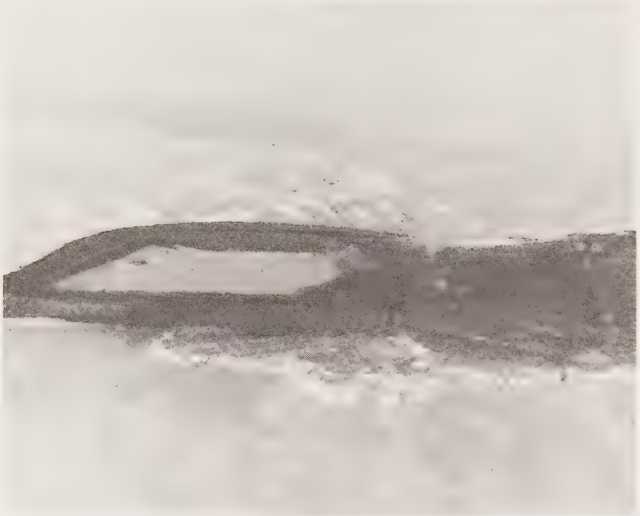
- *Test frozen drilling fluids*
- *Clear snow*
- *Assure sump edge overlap*
- *Backfill excavated material*
- *Compact backfill*
- *Cap sump with topsoil (if applicable)*
- *Provide drainage*

Sump Backfilling Methods

Overlap the sump edges with fill

It is of paramount importance when backfilling any sump that precautions are taken to assure that the outside edges are adequately overlapped. This will reduce the possibility of post-abandonment subsidence of the fill. Place offset stakes 4 m outside of the sump corners to guide bulldozer operators. Alternatively, first spread backfill material around the periphery of the sump and build this "doughnut-shaped" ring up about 1 m in height. Then begin backfilling the centre part.

Failure to compact backfill material can result in post- abandonment subsidence



Overlapping the sump edges
first before backfilling the centre is a good practice

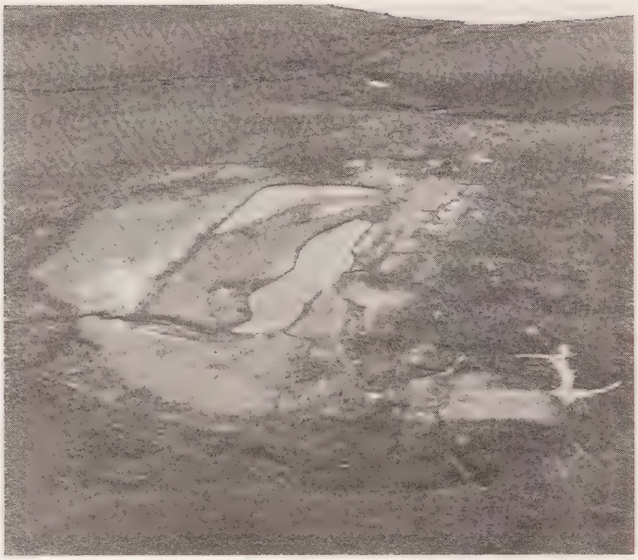
When backfilling a sump in winter conditions, before moving any earth materials, remove snow cover from the frozen fluids surface and stored backfill. Backfills contaminated with snow will subside.

If the sump is to be backfilled in winter and fluids are to be totally contained, test the frozen fluids to insure that they are sufficiently frozen to support the weight of the backfill material without rupturing. If necessary drill sample holes in the ice to test for thickness.

To encourage revegetation, backfill subsoil or parent material first and organic material or topsoil last. To reduce the possibility of later subsidence, compact the backfill material as it is added to break-up lumps. To reduce surface disturbance, restrict heavy machinery to the work area.

Cap the sump

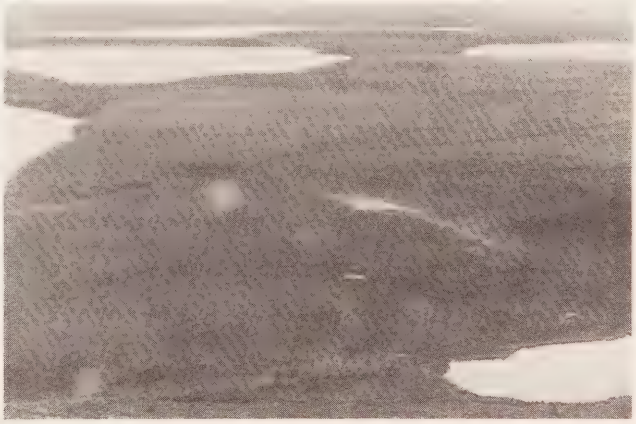
Discourage surface water from entering the abandoned sump and eroding contained muds or fluids. To accomplish this objective, place a well-compacted cap of 1.5 m or more of material over the sump. This cap must overlap the sump edges.



Discourage surface water from invading abandoned sumps

In permafrost areas where granular material is available, ***place a granular cap on the sump surface to insulate the contained fluids and to induce migration of permafrost into them.*** If granular material was used for well-site padding, use it for capping.

Granular material is an excellent source of material for capping abandoned sumps in permafrost



Dirt can be used for sump caps
in permafrost if granular material is unavailable

Camp sumps should be backfilled in the same manner as those for drilling fluids.

Terracing may be required to stabilize some abandoned side-hill sites

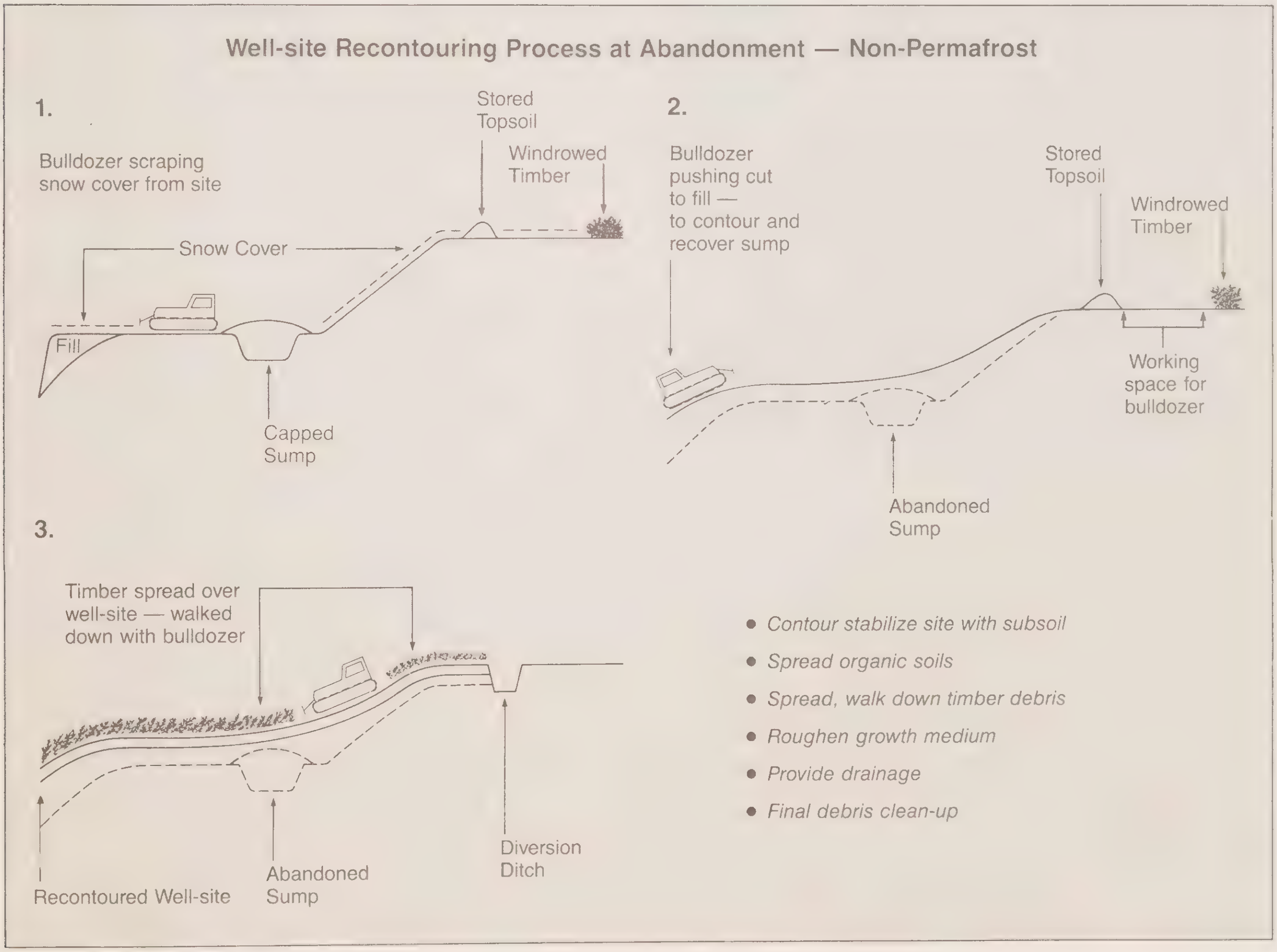
Landscaping and Revegetation

Non-Permafrost

When all sumps have been backfilled, landscape the overall well-site. Depending on soil characteristics, and potential stability problems, it may be advisable to seek professional advice on methods of stabilizing the site. Some sidehill well-sites are terraced at the abandonment stage or special erosion control facilities constructed. In sidehill situations fill material should be pushed back into the cut.

Do not use topsoil for contouring

Spread surface or organic soils that were stored around the well-site over the contoured area. As an erosion control measure spread any windrowed timber over the well-site and walk it down with a bulldozer. It is imperative that a self-maintaining system of drainage facilities be in place when the site is abandoned to prevent surface water from eroding out the well-site — especially abandoned drilling fluids.



Spread windrowed timber over
the abandoned well-site to provide erosion control

Granular pad subsidence can expose abandoned piling butts

Isolate abandoned well-sites from
sources of surface erosion by providing drainage

Leave the well-site surface in a condition that will induce vegetation growth. A roughened surface is preferable to a smooth surface — especially in sloping terrain. For instance, create microsites that promote seed germination by running bulldozer tracks up and down slopes.

A seeding program is advisable and may be required as a term and condition of the land use permit. In the planning phase, a seed and fertilizer mix suitable for local conditions will have been determined. If the well-site is abandoned in winter and is located in level terrain, the seed and fertilizer can be distributed directly onto the snow cover and in most cases will successfully germinate. Alternatively, return to the area and seed it in summer.

A final clean-up should be conducted in summer and any remaining surface debris such as paper and cement bags disposed of then. At well-sites where pilings were used to support platforms, the pilings should be sawed off at ground level or lower.

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Appendix A

List of INAC Offices

Northwest Territories

Regional Manager, Land Resources
INAC
P.O. Box 1500
Yellowknife, N.W.T.
X1A 2R3

District Superintendent
INAC
P.O. Box 2550
Yellowknife, N.W.T.
X1A 2P8

District Manager
INAC
P.O. Box 658
Fort Smith, N.W.T.
X0E 0P0

District Manager
INAC
P.O. Box 2100
Inuvik, N.W.T.
X0E 0T0

District Manager
INAC
P.O. Box 150
Fort Simpson, N.W.T.
X0E 0N0

District Manager
INAC
Rankin Inlet, N.W.T.
X0C 0G0

Assistant District Manager
INAC
Baker Lake, N.W.T.
X0C 0A0

District Manager
INAC
Frobisher Bay, N.W.T.
X0A 0H0

Resource Management Officer
INAC
P.O. Box 1420
Hay River, N.W.T.
X0E 0R0

Resource Management Officer
INAC
P.O. Box 126
Norman Wells, N.W.T.
X0E 0V0

Resource Management Officer
INAC
Fort Liard, N.W.T.
X0G 0A0

Yukon Territory

Regional Manager, Land Resources
Attention: Land Use Section
INAC
200 Range Road
Whitehorse, Yukon
Y1A 3V1

Resource Management Officer
INAC
Watson Lake, Yukon
Y0A 1C0

Resource Management Officer
INAC
Teslin, Yukon
Y0A 1B0

Resource Management Officer
INAC
200 Range Road
Whitehorse, Yukon
Y1A 3V1

Resource Management Officer
INAC
Haines Junction, Yukon
Y0B 1L0

Resource Management Officer
INAC
Beaver Creek, Yukon
Y0B 1A0

Resource Management Officer
INAC
Carmacks, Yukon
Y0B 1C0

Resource Management Officer
INAC
Ross River, Yukon
Y0B 1S0

Resource Management Officer
INAC
Mayo, Yukon
Y0B 1M0

Resource Management Officer
INAC
Dawson City, Yukon
Y0B 1G0

Appendix B

Well-site Checklist

Planning

1. Has early communication been established with INAC Land Use staff?

   ______________________ Yes ☐ No ☐

2. Have potential drilling sites been examined in absence of snow cover?

   ______________________ Yes ☐ No ☐

3. As part of the site selection process, have the following factors about a potential site been considered:

   presence of pingos? Yes ☐ No ☐
   permafrost? Yes ☐ No ☐
   surface drainage conditions? Yes ☐ No ☐
   required set backs? Yes ☐ No ☐
   topographic suitability? Yes ☐ No ☐
   soil conditions? Yes ☐ No ☐
   facility spacing requirements? Yes ☐ No ☐
   other resource values in area? Yes ☐ No ☐
   reclamation potential? Yes ☐ No ☐

4. Has a detailed sketch map of the proposed layout been prepared?

   ______________________ Yes ☐ No ☐

5. Is site set back 100 m from waterbodies?

   ______________________ Yes ☐ No ☐

6. Are separate areas designated for chemical and explosive storage?

   ______________________ Yes ☐ No ☐

7. Are fuel storage areas located uphill of sump?

   ______________________ Yes ☐ No ☐

8. Are solid waste pits 30 m from waterbodies?

   ______________________ Yes ☐ No ☐

9. Is drilling fluid sump 100 m from any ordinary high water mark?

   ______________________ Yes ☐ No ☐

10. Is the sump located in the cut section?

    ______________________ Yes ☐ No ☐

11. Have the following factors been considered in planning the size of the drilling fluid sump:

    depth of hole? Yes ☐ No ☐
    required 1.2 m freeboard? Yes ☐ No ☐
    planned duration of drilling program? Yes ☐ No ☐
    types of formations to be encountered? Yes ☐ No ☐

local precipitation conditions? Yes ☐ No ☐
presence of permafrost? Yes ☐ No ☐
blowing snow conditions? Yes ☐ No ☐
groundwater conditions? Yes ☐ No ☐
potential for drilling fluids to freeze? Yes ☐ No ☐

12. Have plans for the following considerations been prepared:
fuel and hazardous goods? Yes ☐ No ☐
solid waste? Yes ☐ No ☐
forest fires? Yes ☐ No ☐
reclamation? Yes ☐ No ☐

Permitting Procedures

1. Have you obtained an authority to drill? Yes ☐ No ☐
2. Has the land use application been submitted in time to account for the processing period? Yes ☐ No ☐
3. Is the land use application supported by the following technical documentation:
   airphoto interpretation reports? Yes ☐ No ☐
   layout sketch? Yes ☐ No ☐
   plans for fuel and hazardous goods handling, solid waste management, forest fires, reclamation? Yes ☐ No ☐
4. Have other permits been obtained such as:
   quarrying permit? Yes ☐ No ☐
   water license? Yes ☐ No ☐
   timber permits? Yes ☐ No ☐
   burning permits? Yes ☐ No ☐
   others? Yes ☐ No ☐

Construction

1. Has the land use permit been thoroughly reviewed for content? Yes ☐ No ☐
2. Has the name and address of the land use inspector been determined? Yes ☐ No ☐

Site Preparation

3. Has the well-site perimeter been flagged? Yes ☐ No ☐
4. Has the timber been cleared, stockpiled? Yes ☐ No ☐
5. Has the snow been cleared, stored separately? Yes ☐ No ☐
6. Has topsoil been cleared, stored separately? Yes ☐ No ☐
7. Has the site been contoured? Yes ☐ No ☐
8. Have drainage facilities been constructed? Yes ☐ No ☐

Sump Construction

9. Has the sump location been flagged? Yes ☐ No ☐
10. Has the preferred soil deposit area been flagged? Yes ☐ No ☐
11. Has snow cover been stripped? Yes ☐ No ☐

12. Has excavated material been placed on high side of site? Yes ☐ No ☐
13. Has drainage been installed? Yes ☐ No ☐
14. Has the sump been lined if necessary? Yes ☐ No ☐

Rig Area

15. Has site been levelled? Yes ☐ No ☐
16. Has ground surface protection been installed? Yes ☐ No ☐
17. Has drainage towards cellar been constructed? Yes ☐ No ☐
18. Have drilling fluid catch tanks been imbedded as required? Yes ☐ No ☐

Fuel Storage

19. Are fuel dykes of adequate size? Yes ☐ No ☐
20. Are fuel dykes lined? Yes ☐ No ☐

Operation

Solid Waste Management

1. Are combustibles segregated from non-combustibles? Yes ☐ No ☐
2. Are food and wastes securely stored? Yes ☐ No ☐
3. Is there a forced-air, fuel-fired incinerator with spark arrestors on site? Yes ☐ No ☐
4. Are combustibles being burned, buried daily? Yes ☐ No ☐
5. Are solid wastes being placed well below active layer in permafrost? Yes ☐ No ☐

Hazardous Goods, Fuel Handling

6. Is an inventory of goods being maintained? Yes ☐ No ☐
7. Are containers stored upright? Yes ☐ No ☐
8. Are all fuel lines clearly identified? Yes ☐ No ☐
9. Is snow regularly cleared from area? Yes ☐ No ☐
10. Is there an empty tank available for spills? Yes ☐ No ☐
11. Is the area routinely inspected for problems? Yes ☐ No ☐
12. Is an inventory of mud types utilized being maintained? Yes ☐ No ☐

Drilling Fluid, Sump Management

13. Are drilling fluids being segregated from rig wash? Yes ☐ No ☐
14. Are berms showing cracks? Yes ☐ No ☐
15. Are fluids at desired level? Yes ☐ No ☐
16. Is the sump relatively free from snow? Yes ☐ No ☐
17. In the event of a problem with sump size, have the following counter measures been considered:
    - supplementary sump construction? Yes ☐ No ☐
    - decant? Yes ☐ No ☐
    - drilling suspension? Yes ☐ No ☐
18. In the event of a proposed decant, have the following measures been taken:
    - drilling fluids treated? Yes ☐ No ☐

- fluid samples obtained? Yes ☐ No ☐
- samples sent to laboratory for water quality analysis and bioassay? Yes ☐ No ☐
- application submitted with all required information? Yes ☐ No ☐
- disposal area staked and flagged? Yes ☐ No ☐

Abandonment and Restoration

Waste Disposal by Burial

1. Are all desired wastes in pit? Yes ☐ No ☐
2. Are wastes compacted? Yes ☐ No ☐
3. Are wastes well below active layer? Yes ☐ No ☐
4. Is backfill compacted? Yes ☐ No ☐
5. Does backfill capping overlap pit edges? Yes ☐ No ☐

Drilling Fluid Disposal

6. Has one of the following methods appropriate to the location been chosen for fluid disposal:
   - downhole? Yes ☐ No ☐
   - decant? Yes ☐ No ☐
   - squeeze? Yes ☐ No ☐
   - trenching? Yes ☐ No ☐
   - total containment? Yes ☐ No ☐

Sump Backfilling

7. Are remaining fluids adequately frozen? Yes ☐ No ☐
8. Is snow removed from sump surface? Yes ☐ No ☐
9. Is sump perimeter adequately overlapped? Yes ☐ No ☐
10. Is the sump area capped? Yes ☐ No ☐
11. Is drainage provided? Yes ☐ No ☐

Landscaping, Revegetation

12. Has snow been stripped from site? Yes ☐ No ☐
13. Has the site been recontoured with parent material or subsoil? Yes ☐ No ☐
14. Have stored organic soils been spread over recontoured site? Yes ☐ No ☐
15. Has windrowed timber been respread, walked down? Yes ☐ No ☐
16. Has drainage been installed? Yes ☐ No ☐
17. Has growth medium for revegetation been surface prepared? Yes ☐ No ☐
18. Has area been seeded/fertilized? Yes ☐ No ☐
19. Has remaining surface debris been disposed of? Yes ☐ No ☐